COSEWIC
Assessment and Update Status Report

on the

Wolverine
Gulo gulo

Eastern population
Western Population

in Canada

EASTERN POPULATION – ENDANGERED
WESTERN POPULATION – SPECIAL CONCERN
2003

COSEWIC
COMMITTEE ON THE STATUS OF
ENDANGERED WILDLIFE IN
CANADA

COSEPAC
COMITÉ SUR LA SITUATION DES
ESPÈCES EN PÉRIL
AU CANADA

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For additional copies contact:

COSEWIC Secretariat
c/o Canadian Wildlife Service
Environment Canada
Ottawa, ON
K1A 0H3

Tel.: (819) 997-4991 / (819) 953-3215
Fax: (819) 994-3684
E-mail: COSEWIC/COSEPAC@ec.gc.ca
http://www.cosewic.gc.ca

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COSEWIC
Assessment Summary

Assessment Summary – May 2003

Common name
Wolverine (Eastern Population)

Scientific name
Gulo gulo

Status
Endangered

Reason for designation
There have been no verified reports of this species in Quebec or Labrador for about 25 years, but there are unconfirmed reports almost every year. Any remaining population would be extremely small and therefore at high risk of extinction from stochastic events such as incidental harvest. The apparent lack of recovery despite the recent high local abundance of caribou suggests that this population may be extirpated.

Occurrence
Quebec, Newfoundland-Labrador

Status history
Canadian range considered as one population in April 1982 and designated Special Concern. Split into two populations in April 1989 (Western population and Eastern population). Eastern population was designated Endangered in April 1989 and confirmed in May 2003. Last assessment was based on an update status report.

Assessment Summary – May 2003

Common name
Wolverine (Western population)

Scientific name
Gulo gulo

Status
Special Concern

Reason for designation
Estimated total population size exceeds 13,000 mature individuals. Declines have been reported in Alberta and parts of British Columbia and Ontario. A distinct subspecies may be extirpated from Vancouver Island. Many pelts used locally are not included in official statistics, and harvest levels may be underreported. There is no evidence, however, of a decline in harvest. There are no data on overall population trends other than those provided by local knowledge and harvest monitoring programs. This species' habitat is increasingly fragmented by industrial activity, especially in the southern part of its range, and increased motorized access will increase harvest pressure and other disturbances. The species has a low reproductive rate and requires vast secure areas to maintain viable populations.

Occurrence
Yukon Territory, Northwest Territories, Nunavut, British Columbia, Alberta, Saskatchewan, Manitoba and Ontario

Status history
Canadian range considered as one population in April 1982 and designated Special Concern. Split into two populations in April 1989 (Western population and Eastern populations). Western population was designated Special Concern in April 1989 and confirmed in May 2003. Last assessment was based on an update status report.

Executive Summary

Wolverine
Gulo gulo

Species information

Wolverines are a medium-sized carnivore and the largest terrestrial member of the weasel family in North America, appearing more like small bears than weasels. A single subspecies of wolverine ranges across most of Canada. Further studies are required to determine if the Vancouver Island population is a separate subspecies. Several wolverine populations may be isolated from the main population, including those of the arctic and Pacific islands, and that of Quebec and Labrador.

Distribution

Wolverines are found across northern Eurasia and North America. In Canada they are found in northern forested wilderness areas across the country, in alpine tundra of the western mountains, and in arctic tundra. They formerly occupied habitats that were disturbed by humans in the Prairie Provinces and eastern Canada.

Habitat

A wide variety of forested and tundra habitats is used by wolverines in wilderness areas. Habitats must have an adequate year-round supply of food that consists of smaller prey species, such as rodents and snowshoe hares, used more in summer, and the carcasses of larger animals, like moose and caribou, which are an important part of the winter diet. Females den at higher elevations under rocks, logs or snow. The snow cover must persist late into the spring to insulate the den and food must be close at hand. Forestry, hydroelectric developments, oil and gas and mineral exploration and development, and transportation corridors continue to alter, remove or fragment habitats. About 6% of all current wolverine range is within parks and protected areas, and 10% of the best habitats in western Canada are protected.

Biology

Most females do not breed until they are 2 years old, and thereafter they do not breed every year. Litter sizes average about 3 kits. Wolverines breed in the summer when females are more sedentary, with the implantation of the blastocyst delayed until winter. Wolverines face mortality from predation and starvation. Human-caused mortality factors, such as trapping, hunting and road/railway kill, are also significant, and

may increase as settlement of remote areas increases. The growth rate of kits is rapid, placing nutritional demands on the mother. They occupy home ranges which can be 50-400 km^2 for females and 230-1580 km^2 for males. Juveniles may have even larger ranges and can disperse over 300 km. Home ranges may overlap within and between sexes but, overall, wolverine densities are low; about 5/1000 km^2 in good habitats. Wolverines are scavengers and predators, often caching food for future use.

Population sizes and trends

Population size is difficult to estimate; however, combined estimates of about 9200 wolverines for the Yukon, British Columbia and Manitoba may be extrapolated to 15,000 to 19,000 across Canada, based on areas of occupancy and relative densities. Pre-trapping population estimates likely exceed 20,000. Wolverine populations in many areas of Canada are benefiting from the cessation of wolf poisoning and wolf control, harvest closures, advanced trapline and harvest management systems and ungulate (e.g., caribou) population gains. Wolverine range continues to decline in northern Ontario; however, recent increases have been noted in northwestern Ontario and Manitoba, where caribou have increased. The populations are stable and healthy elsewhere, except locally in Alberta and British Columbia, where caribou have declined. Wolverine, possibly a separate subspecies, may be extirpated from Vancouver Island. The eastern wolverine population is either extremely scarce or extirpated.

Limiting factors and threats

The ability of wolverine populations to recover and repopulate vacant habitats is naturally low. Other factors limiting populations include harvest, including trapping on the periphery of protected areas, disruptions to important ecosystem components such as wolves, moose and caribou, disturbance of denning areas by recreational users, and threats to habitats. Habitat fragmentation in southern areas may destabilize populations.

Special significance of the species

Wolverines are indicators of ecosystem health. Populations are considered vulnerable worldwide. The fur is valued for its frost-resistant properties. Aboriginal peoples have viewed wolverines as both spiritual guides and relentless enemies. A mythology and folklore exist around the wolverine's ferocity and cunningness.

Existing protection or other status designations

The eastern population is not harvested, and the western population is harvested in all jurisdictions except Ontario, with some regional closures in place. The provincial and CDC rankings are: critically imperilled in Quebec, endangered in Labrador, threatened in Ontario, and vulnerable or sensitive throughout most of the west and north. Wolverines on Vancouver Island are considered critically imperilled by the provincial government.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild species, subspecies, varieties, and nationally significant populations that are considered to be at risk in Canada. Designations are made on all native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fish, lepidopterans, molluscs, vascular plants, lichens, and mosses.

COSEWIC MEMBERSHIP

COSEWIC comprises representatives from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership), three nonjurisdictional members and the co-chairs of the species specialist groups. The committee meets to consider status reports on candidate species.

DEFINITIONS

Species	Any indigenous species, subspecies, variety, or geographically defined population of wild fauna and flora.
Extinct (X)	A species that no longer exists.
Extirpated (XT)	A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A species facing imminent extirpation or extinction.
Threatened (T)	A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)**	A species that has been evaluated and found to be not at risk.
Data Deficient (DD)***	A species for which there is insufficient scientific information to support status designation.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.
** Formerly described as "Not In Any Category", or "No Designation Required."
*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list.

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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

Update
COSEWIC Status Report

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Gulo gulo

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Western population

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TABLE OF C0NTENTS

SPECIES INFORMATION 4
Name and classification 4
Description 4
Nationally significant populations 5
DISTRIBUTION 5
Global range 5
Canadian range 7
HABITAT 7
Habitat requirements 7
Trends 9
Protection/ownership 9
BIOLOGY 10
General 10
Reproduction 10
Survival 11
Physiology 11
Movements/dispersal 12
Nutrition and interspecific interactions 12
Behaviour/adaptability 13
POPULATION SIZES AND TRENDS 13
Yukon Territory 14
Northwest Territories 15
Nunavut Territory 17
British Columbia 18
Alberta 18
Saskatchewan 19
Manitoba 19
Ontario 20
Quebec and Labrador 20
New Brunswick 21
National parks 21
Canadian wolverine population estimate 22
Alaska 22
Coterminous United States 23
LIMITING FACTORS AND THREATS 23
Biological factors 23
Harvest and predator control 23
Habitat threats 25
SPECIAL SIGNIFICANCE OF THE SPECIES 26
EXISTING PROTECTION OR OTHER STATUS 26
SUMMARY OF STATUS REPORT 28
TECHNICAL SUMMARY 30
ACKNOWLEDGEMENTS 32

LITERATURE CITED 32
BIOGRAPHICAL SUMMARY OF CONTRACTOR 38
AUTHORITIES CONSULTED 39

List of figures

Figure 1. Illustration of *Gulo gulo*. 4
Figure 2. North American distribution of *Gulo gulo* 6
Figure 3. Canadian distribution of *Gulo gulo* 8

List of tables

Table 1. Wolverine pelts produced in Canada, 1988/89 to 2000/01. 17
Table 2. Status of wolverine in Canada. 28

SPECIES INFORMATION

Name and classification

The wolverine, *Gulo gulo* (Linnaeus, 1758), was formerly known as *Gulo luscus* in North America; however, New and Old World forms have been shown to be conspecific (Kurtén and Rausch 1959). Four subspecies are recognized in North America (Hall 1981), two of which occur in Canada; *Gulo gulo luscus*, found across Canada, Alaska and the northwestern United States, and *Gulo gulo vancouverensis*, found on Vancouver Island. Banci (1982) found little evidence for classifying the Vancouver Island population as a distinct subspecies; however, it has undergone a high degree of isolation since the Pleistocene, and is still recognized as a distinct subspecies (Nagorsen 1990, Resources Inventory Committee 2002). A complete study of variation throughout the species' range has been recommended (Nagorsen 1990).

Description

The wolverine is the largest terrestrial mustelid in North America and resembles a small bear in appearance more than a weasel (Figure 1). It has long, glossy coarse fur, which varies from brown to black, often with a pale facial mask and yellowish or tan stripes running laterally from the shoulders, crossing just above the tail. Some individuals have a white patch on the neck and chest. It has a large head, broad forehead, short stout neck, short stocky legs, and a heavy musculature. The feet are large, ears short and the tail is long and bushy. The skull structure is robust, allowing it to crush bones and frozen carcasses. Wolverines are sexually dimorphic with adult females ranging in size from 7.5 to 11 kg and males weighing 12 to 16 kg (Banci 1994, Copeland 1996, Lofroth 2001, Peterson 1966). Total length averages about 1 m, with the average tail length being 23 cm. Its general characteristics are described by Wilson (1982), Hash (1987), and Pasitschniak-Arts and Larivière (1995).

Figure 1. Illustration of *Gulo gulo*.

Nationally significant populations

The original COSEWIC status designation for wolverine was "Rare" (equivalent to "Special Concern" prior to 1990) (Kelsall 1981). In 1989, two geographically separated populations were delineated, the eastern population of Quebec and Labrador, and the western population of northwestern Ontario, Manitoba, Saskatchewan, Alberta, British Columbia, Northwest Territories and Yukon Territory. The eastern population was assigned the status of "Endangered" and the western population was "Vulnerable" (equivalent to "Special Concern" from 1990 to 1999) (Dauphiné 1989).

The eastern population was isolated from the western population in historical times (Dawson 2000), and densities have declined from low levels to possible extirpation (Fortin et al. 2002). There is a draft recovery plan in place (Fortin et al. 2002).

Similar geographic isolation has occurred for the Vancouver Island, Pitt Island (north coast of British Columbia) and some or all of the arctic island sub-populations. Gene flow among these and other sub-populations has not been studied. Recent studies by Kyle and Strobeck (2001, 2002) have shown genetic structuring of wolverine sub-populations in Manitoba-Ontario, southern British Columbia (Revelstoke sample) and Idaho, suggesting varying degrees of isolation from the once panmictic Canadian population. There has been no evidence of wolverines on Vancouver Island since 1992 and the population and/or subspecies may be extirpated (Lofroth, pers. com., 2002).

The Southern Mountain national ecological area (see COSEWIC national ecological area map http://www.cosewic.gc.ca/cosewic/images/ecomap.gif) sub-population is vulnerable to habitat fragmentation and subsequent decreased viability. Genetically distinct populations occur in the United States and Scandinavia, due in part to population fragmentation (Kyle and Strobeck 2001, Walker et al. 2001). Wolverines from near Revelstoke, British Columbia have differentiated from the continuous northern population due to a barrier to gene flow, although not to the degree of the Idaho population (Kyle and Strobeck 2002).

DISTRIBUTION

Global range

The wolverine is a holarctic species that ranges across North America and Eurasia, occupying Canada, United States, Finland, Norway, Sweden, Estonia, Russian Federation and Mongolia (Hilton-Taylor 2000).

Wolverine range in the contiguous United States has declined with human settlement since the mid-19th century. It has been extirpated from most of its range in the northeast, Great Lakes states and high plains where it occurred at low densities and where the range limits were uncertain (deVos 1964, Hamilton and Fox 1987, Wilson 1982, Predator Conservation Alliance 2001; Figure 2). Populations in the western

states have suffered fragmentation and declines (Banci 1994). They may have ranged as far south as Arizona and New Mexico; however, tenuous populations currently inhabit only montane regions in Washington, Oregon, California, Idaho, western Montana, Wyoming and Colorado (Banci 1994). Remnant populations also exist in the southern Rockies (Colorado; Kahn and Byrne 1998) and, possibly, Michigan and Maine.

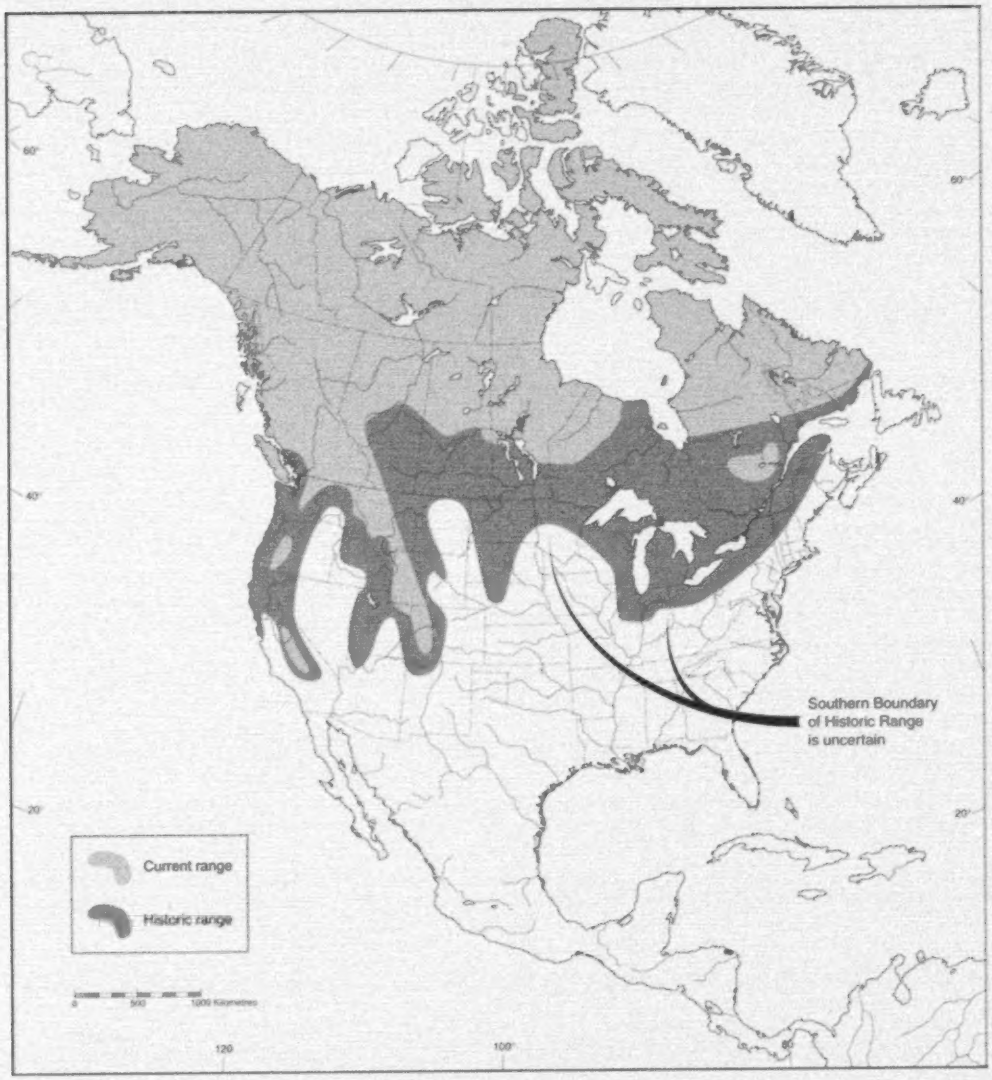

Figure 2. North American distribution of *Gulo gulo*. Adapted from Hash (1987), Johnson (1990), and Fortin et al. (2002), and modified from Berezanski (pers. com., 2002), Carrière (pers. com., 2002), Dawson (pers. com., 2002), Kosinski (pers. com., 2002), Popko (pers. com., 2002), Jessup (pers. com., 2003), Magoun (pers. com., 2003), and Mulders (pers. com., 2003).

The historic range of wolverines in North America typically described in the literature (e.g., Kelsall 1981) was compiled from anecdotal evidence such as personal accounts and the interpretation of fur returns, which are often tied to socio-economic factors and not furbearer populations at the source of the data collection. Fur trade companies such as Hudson's Bay Company and the North West Company traded over large areas which encompassed several of today's jurisdictions (Novak et al. 1987, Obbard et al. 1987). It is doubtful whether viable populations ever occurred in the Prairie or Great Lakes Plains ecological areas, yet these areas are commonly indicated as historic wolverine range. None of the areas from which the species has been presumably extirpated ever produced significant numbers of wolverine pelts. Furthermore, the aspen parkland bordering the prairies and other habitats on the edge of the wolverine's present range (Figure 2) may have represented population sinks rather than reservoirs. There have been few studies of wolverines in North America and the extent of the animal's historic distribution remains unknown.

Canadian range

The current Canadian range of the wolverine (Figure 3) includes all COSEWIC ecological areas (Boreal, Arctic, Northern Mountain, Southern Mountain and Pacific) except Atlantic, Prairie and Great Lakes Plains. Wolverines historically never occurred in Newfoundland, Nova Scotia, Prince Edward Island, the Queen Charlotte Islands, and some islands of the northwestern Arctic Archipelago in the Northwest Territories and Nunavut (Dauphiné 1989). Arctic islands supporting wolverine include Victoria, Stefansson, Prince of Wales, Somerset, Devon, Cornwall, Amund Ringnes, Ellesmere, Baffin, Bylot, Southampton, Coates, and Mansel (Carrière, pers. com., 2002). Wolverines occur on at least two Pacific islands, Vancouver (if extant) and Pitt (MacLeod 1950).

Range reductions began in the mid-19th century, where it was extirpated in New Brunswick, and from much of Boreal Ontario, Quebec and Labrador, and in the aspen parkland of Manitoba, Saskatchewan and Alberta (Dauphiné 1989).

HABITAT

Habitat requirements

In a previous COSEWIC status report, Kelsall (1981) reviewed the available data and concluded that wolverine "habitat is probably best defined in terms of an adequate year-round food supply in large, sparsely inhabited wilderness areas, rather than in terms of particular types of topography or plant association...the animals are most abundant where large ungulates are common, and where carrion is abundant in winter from hunter kills, predation and natural mortality."

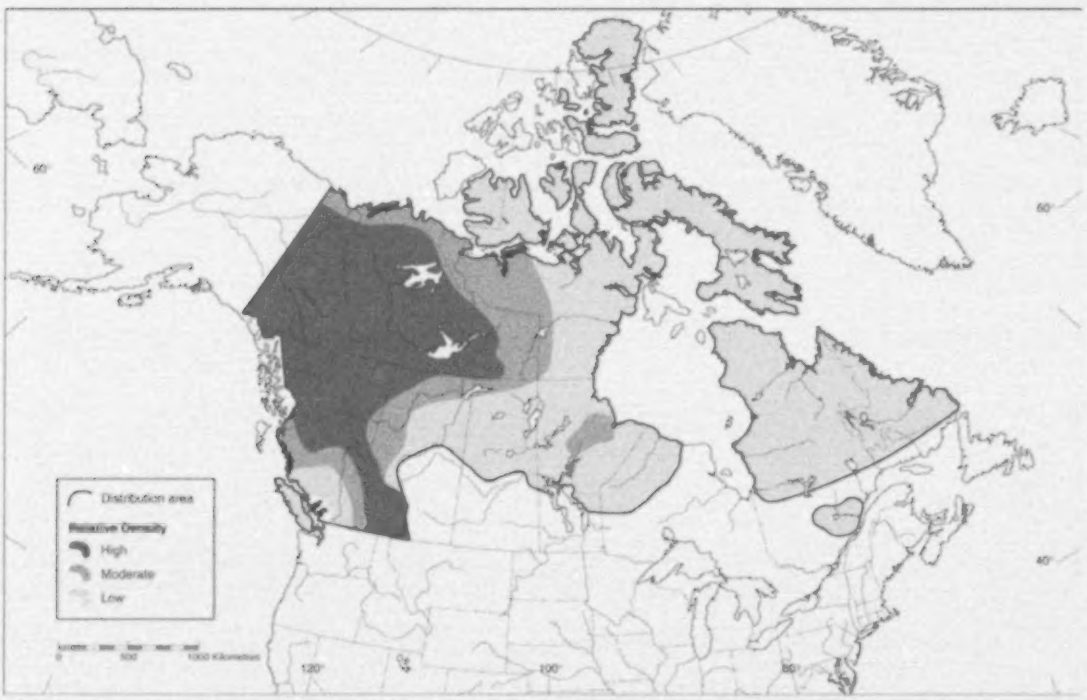

Figure 3. Canadian distribution of *Gulo gulo*. Adapted from Hash (1987), Johnson (1990), and Fortin et al. (2002), and modified from Berezanski (pers. com., 2002), Carrière (pers. com., 2002), Dawson (pers. com., 2002), Kosinski (pers. com., 2002), Popko (pers. com., 2002), Jessup (pers. com., 2003), Magoun (pers. com., 2003), and Mulders (pers. com., 2003).

Wolverines inhabit a variety of treed and treeless ecological areas, at all elevations. In mountainous areas adult females tend to use higher elevations and steeper terrain more than other sex and age classes, while adult males and subadults of both sexes make extensive use of low elevation habitats (Lofroth 2001). Lower elevation habitats are used more in winter (Landa et al. 1998). Adult females may be reducing the risk of predation on their kits by choosing the more rugged terrain (Golden, pers. com., 2003). High densities of wolverines occur in the mountainous areas of the Yukon Territory, Northwest Territories, British Columbia and Alberta, where habitats, prey species, and ungulates are most diverse and abundant (Boreal, Northern Mountain and Southern Mountain ecological areas). Viable populations of other large carnivores, as providers of carrion, may be important. In a study on wolves (*Canis lupus*) in the Yukon, wolverines frequently visited moose (*Alces alces*) and caribou (*Rangifer tarandus*) kills after wolves had left (Hayes, pers. com., 2002). There have been no field studies of wolverines on the arctic or Pacific islands, nor in Quebec, Labrador or the Prairie Provinces.

Wolverines have specific habitat requirements for den sites. Wolverine dens may be classified as natal or maternal, and multiple dens may be used in sequence (Copeland 1996). Dens are constructed either in boulders, under deadfall, or in snow tunnels (Magoun and Copeland 1998) at higher elevations, including tundra habitats. Dens or

exposed sites may also be used for rendezvous between female and kits, and resting. Additional requirements are protection from predators such as golden eagles (*Aquila chrysaëtos*), bears (*Ursus arctos* and *U. americanus*) and wolves. Adequate insulating snow cover that persists throughout the denning period and proximity to kit rearing habitat are also important. Individual wolverines may reoccupy den sites or denning habitats for several consecutive years (Magoun 1985, Lee and Niptanatiak 1996).

Trends

Considerable wolverine habitat was lost or fragmented with the extensive settlement that occurred in the late 19th and 20th centuries at the southern edge of the range (van Zyll de Jong 1975). Losses were due primarily to human settlement, agriculture, and forestry. Most wolverine habitat was supplanted, and wolverine populations were reduced by hunting, trapping and poisoning, using poison baits directed at wolves. The removal of ungulates, an important winter prey base, also likely contributed to their extirpation. Reduced numbers of prey remains a significant threat to wolverine populations today, especially where mountain caribou (*Rangifer tarandus caribou*) herds are being impacted by forestry operations and overhunting. Much of the habitat lost during human colonization was not prime habitat (assuming low fur returns are correlated with populations and not effort), and numerical losses of wolverines may have been low.

Habitat fragmentation has resulted in isolated and threatened populations in the western coterminous United States (Banci 1994), and this process may be occurring in the Southern Mountain national ecological area of southern British Columbia and Alberta, and in northeastern Manitoba-northwestern Ontario (Kyle and Strobeck 2002). Across the range of wolverines, forestry, oil and gas and mineral exploration and development, and large hydroelectric reservoirs threaten habitat. Transportation corridors act as barriers to movement and essentially divide habitats and isolate populations (Austin 1998).

Both Kelsall (1981) and Dauphiné (1989) assumed that the relatively large number of parks and protected areas, which act as refugia from trapping and development in western Canada, had secured wolverine habitat in that area. However, human recreation, such as snowmobiling and other forms of snow travel, disturbs wolverines, particularly during the denning season in February-March (Heinemeyer et al. 2001). These activities are generally permitted and occur with great frequency both within and outside of protected areas. As well, trapping is permitted in many protected areas, and wolverines that range beyond protected area boundaries are vulnerable to trapping.

Protection/ownership

Most of the wolverine's range is on public or "Crown" lands although First Nations' and Inuvialuit land claims have resulted in ownership of lands in the Yukon Territory, the Northwest Territories, Nunavut and British Columbia. Both Aboriginal and non-Aboriginal lands are subject to government-permitted land use activities.

Approximately 6% of the wolverine's current range and 10% of the "high" relative density range in western Canada (Figure 3) is within parks and protected areas (Mulder, pers. com., 2003). The process of establishing parks and protected areas on Aboriginal lands is continuing.

Trapping is permitted, although it occurs infrequently, in many British Columbia provincial parks, in all national parks in the Yukon Territory, Northwest Territories, and Nunavut Territory, and in Wood Buffalo (Northwest Territories and Alberta) and Wapusk (Manitoba). Large, contiguous or connected blocks of suitable habitat are needed for wolverine conservation (Weaver et al. 1996). The establishment and maintenance of movement corridors between parks would strengthen wolverine population viability in the Southern Mountain ecological area of British Columbia and the western United States.

Most types of resource extraction or major habitat changes are not permitted in protected areas. However, recreational activities, such as snowmobiling and skiing which may disturb denning wolverines, are generally not restricted and transportation corridors bisect and penetrate parks. The Trans-Canada Highway, an impediment to the free movement of wolverines (Austin 1998), traverses Banff, Yoho and Glacier National Parks, and borders Revelstoke National Park.

BIOLOGY

General

This document is not intended to provide a comprehensive literature review of wolverine biology, since many published reviews exist (Wilson 1982, Hash 1987, Hatler 1989, Banci 1994, Petersen 1997, Biodiversity Legal Foundation 2000, Dawson 2000, Fortin et al. 2002). Rather, recent literature and personal communications, which provide essential information for a scientific assessment of the current status of wolverines in Canada, are assigned priority. Despite the apparent wealth of literature on wolverines, they remain one of the least studied North American medium to large-sized carnivores.

Habitat and population changes since the previous COSEWIC assessment are important criteria for determining the current status. Aspects of the species biology which contribute to the wolverine's resiliency to harvest, sensitivity to habitat change and ability to re-colonize unsaturated or vacant habitats are also vital for assessing population vulnerability.

Reproduction

The reproductive rate and hence the population resiliency of wolverines is relatively low. Most wolverines become sexually mature at two years of age (Rausch and Pearson 1972, Banci and Harestad 1988). The proportion of adult female

carcasses that were pregnant ranged from 92% (Rausch and Pearson 1972) to 74% (Banci and Harestad 1988). The pregnancy rate declined from 92% for 2 year olds to 37% for combined 6 year old and older age classes. Delayed implantation of the blastocyst permits breeding in summer when females tend to be more sedentary. The average number of fetuses ranged from 2.8 to 3.4 in a Yukon study (Banci and Harestad 1988). The latter study was based on carcasses, therefore the actual litter size, following the re-absorption of fetuses and stillbirths, was lower. The size of litters is greatest for females over the age of 6 (Banci 1994), but the pregnancy rate for those older females is lower. Reproductive rates observed in Alaska and Idaho were 0.69 and 0.89 kits per female per year respectively (Magoun 1985, Copeland 1996), since females gave birth 2 or more years apart. The rate of mortality among kits and the most successful age classes of females at raising kits to weaning are unknown factors.

The fact that female reproductive rates are highest in early adult years has implications for trapline management using untrapped areas as population refugia. The maintenance of refugia from trapping will ensure that older females are conserved, since trapping removes resident animals and vacant habitats are generally colonized by dispersing juveniles.

There is some debate over whether wolverine populations fluctuate with snowshoe hare (*Lepus americanus*) cycles, or if increased trappability leads to the perception of wolverine fluctuations (Hatler 1989). Hares are an important component of the wolverines' diet (Banci 1987). Banci (1987) noted an increase in the harvest of adult males in March 1983 following the snowshoe hare population crash in 1982-83.

Survival

Wolverines are preyed on by bears, wolves, cougars (*Puma concolor*), golden eagles and other wolverines. These other predators may be encountered with greater frequency at carrion. In a summary of mortality rates of radio-collared wolverines from 12 studies, J. Krebs (pers. com., 2002) found that human caused mortality from trapping and road/rail kill accounted for 46% of deaths. Natural sources of mortality included predation by wolves, cougars and conspecifics (30% of non-human causes), and starvation (49% of non-human causes). Survival was < 0.75 among all age/sex classes in trapped areas, and > 0.84 in areas where trapping did not occur. Intrinsic rates of increase (λ) were estimated at 0.88 in trapped populations and 1.06 in untrapped populations. Survival was highest among adult females (0.88 in untrapped areas, 0.73 in trapped areas) and lowest among subadult males (0.45 in trapped areas) (Krebs, pers. com., 2002). This evidence suggests that trapped populations would decline without immigration from refugia from trapping.

Physiology

Wolverine kits reach adult body size by 7 months of age (Magoun 1985). Rapid growth of the energy-producing tissues (liver, heart, brain, and kidneys) requires a high metabolic rate early in life, which in turn places high energetic demands on the mother

(Wilson 1982). The high metabolic rate should improve kits ability to thermoregulate during long foraging trips by the mother. Kits are weaned at 9-10 weeks (Banci 1994). Both mother and kits may require more carbohydrates near the time of weaning when energy requirements peak (Wilson 1982).

Movements/dispersal

Wolverines typically occupy home ranges that vary from about 50-400 km^2 for females and 230-1580 km^2 for males (Hornocker and Hash 1981, Gardner 1985, Magoun 1985, Whitman et al. 1986, Banci 1987, Copeland 1996). Lofroth (2001) documented an average home range of 3500 km^2 for dispersing subadult males. There may be home range overlap between members of the same and opposite sexes (Krebs and Lewis 2000, Lofroth, pers. com., 2002), however this is poorly understood. Intersexual overlap is considered to be more common. A proportion of the population is transient at any given time. Transients are typically, but not always, yearlings. Yearling females tend to establish home ranges nearer their natal ranges than yearling males do, although both sexes are capable of long distance movements (Magoun 1985, Gardner et al. 1986, Mulders 2000). Males can disperse over 200 km (Copeland 1996; n=3), 378 km (Gardner et al. 1986), and 73 to 326 km (Mulders 2000; n=3). Magoun (1985) reported a 300 km movement by a female of unknown age, and Mulders (2000) reported movements by 5 females between 69 and 225 km. When estimating population densities, home range overlap and the presence of transients must be considered. Simple home range extrapolation (e.g., Banci 1994) results in an underestimation of population size.

Vangen et al. (2001) attributed sex-biased dispersal patterns to resource competition between females and competition for mates by males. Wolverines are able to traverse rugged terrain, including tundra and glaciers that would act as barriers to many species of mammals. Dispersal characteristics likely gave wolverines the capacity to recolonize gaps in their distribution in Scandinavia (Vangen et al. 2001). However, long distance movements place individuals at greater risk of mortality due to predation, trapping, accident or starvation (Copeland 1996).

The large home range size of wolverines increases its susceptibility to trapping. Refugia from trapping must necessarily be large enough to protect entire ranges of wolverines. The propensity of juveniles to disperse long distances is a key factor in gene flow.

Nutrition and interspecific interactions

Wolverines are scavengers and predators, opportunistically feeding on abundant or readily procurable food. Fresh prey are eaten more during summer and carrion, including cached items, is used more in winter (Magoun 1987). Prey species may include rodents, snowshoe hares, birds, and young ungulates. The most common sources of carrion are caribou, moose (*Alces alces*), mountain sheep (*Ovis dalli* and *O. canadensis*), mountain goats (*Oreamnos americanus*), deer (*Odocoileus hemionus*

and *O. virginianus*), and elk (*Cervus elaphus*) (Gardner 1985, Banci 1987, Magoun 1987, Mulders 2000, Lofroth 2001). Fish and marine mammals are also scavenged. Wolverines will also eat plant material such as berries. Studies in northern and southeastern British Columbia have shown that caribou and marmots (*Marmota* spp.) are important foods for denning females (Lofroth, pers. com., 2002). Marmots and other sciurids are important to adult females throughout the summer.

Large carnivores such as grizzly bears, wolves and cougars require large tracts of wilderness ecosystems which mirror the wolverine's requirements but, more importantly, they generate carrion for wolverines. These carnivores compete with wolverines at kill sites, and are a potential source of wolverine mortality.

The highest densities of wolverines occur in the mountainous areas of the Yukon Territory, Northwest Territories, British Columbia and Alberta, where habitats, prey species, and ungulates are most diverse and abundant (Figure 3).

Behaviour/adaptability

Wolverines prefer pristine areas; however, home ranges frequently overlap active traplines, cross-country ski trails, busy roads such as logging roads (E. Lofroth, per. com. 2002) and the edges of communities. However, large highways and other transportation corridors may act as barriers to movements and dispersal, and are significant sources of mortality. Austin (1998) found that wolverines avoided areas within 100 m of the Trans Canada Highway and preferred areas more than 1100 m away. They selected narrow crossings (<100 m). Lofroth (2001) hypothesized that wolverines prefer uncut forest stands within a matrix of cut and uncut stands, particularly where forest roads are active, a behaviour that increases trap vulnerability.

Wolverines are curious, and will investigate campsites, food caches and even cabins when humans are not present. Their propensity to "rob" food caches and cabins is a contributing factor in their mythology. Wolverines will opportunistically use snowmobile trails for travel and scavenging trapped animals and hunter kills. Wolverines are thought to be highly secretive; however, they are occasionally observed at a distance by people hiking or skiing above treeline and on glaciers, and hiking and rafting in the Arctic. In the Arctic, wolverines are frequently hunted from snowmobiles.

Denning females are sensitive to disturbance caused by researchers (Magoun and Copeland 1998), therefore snowmobiling and back-country skiing may similarly impact reproductive success (Heinemeyer et al. 2001, Lofroth, pers. com., 2002). Den relocation or litter abandonment may result.

POPULATION SIZES AND TRENDS

The earliest harvests attributed to specific Canadian jurisdictions indicate that wolverine populations, based on harvest success, may have been declining in the

Prairie Provinces in the 1920s and 1930s (Novak et al. 1987). Harvests in Quebec, Labrador and Ontario were already low by that time. Fur harvest is dependent on factors in addition to furbearer population levels, including weather and economic conditions (fur prices and alternative employment opportunities) which influence trapper effort.

Low densities, large home range sizes, and long-distance movements by dispersing individuals contribute to the wolverines' vulnerability to trapping. Despite these factors, some local populations appear to have recovered from local overharvest. Improved fur harvest systems, such as registered traplines, and trapper education, applied over several decades, have contributed (Johnson 1990). Exceptions appear to be the eastern wolverine population, which was probably historically low and remains either very rare or extirpated. Populations in the Pacific region, including Vancouver Island and the lower mainland, have similarly become very rare or extirpated.

Yukon Territory

Wolverines are considered high priority for management attention in the Yukon, where the population is monitored using fur harvest statistics, winter track counts and an annual trapper questionnaire to obtain local knowledge about populations and trends from all licensed trappers (Slough et al. 1987, Slama, pers. com., 2002). All evidence points to a healthy and stable population in all regions of the territory over the past 20 years (Slama, pers. com., 2002). Trappers report wolverines to be common, and harvests are not declining relative to trapping pressure (Slama and Jessup, pers. com., 2002). Wolverine pelts must be sealed in the Yukon, including pelts held over or used in the territory, and those taken by First Nation's trappers. Wolverines harvested by Inuvialuit trappers are not sealed and enter the Northwest Territories. Trappers have reported wolverines to be particularly abundant since the snowshoe hare population crash in 1999 (Jung, pers. com., 2002). Alternative hypotheses to numerical abundance include the increased trappability of wolverines when food supplies decrease (Banci 1987), or an increase in dispersing juveniles following reproductive success at the hare peak.

There are few long term data sets on wolverine abundance, other than inferences from fur harvest and trapper questionnaire data; however, long term winter track count data has been collected in the Yukon. O'Donoghue et al (2001) reported 0.69 to 15.83 wolverine tracks per 100 km-days (transect length in km x days since last snowfall) of transect in the Kluane area between 1986-87 and 1996-97. Wolverine tracks were most common during the second winter of hare population decline (1991-92; 5.68 tracks per 100 km-days) and during the subsequent hare increase phase (5.64 and 15.83 tracks in 1995-96 and 1996-97, respectively). In the Teslin burn, 300 km to the east, B. Slough (unpubl. data) recorded 0 to 20.44 wolverine tracks per 100 km-days between 1986-87 and 1993-94. The peak track density occurred in 1993-94, during the third winter of hare decline in that area.

Banci and Harestad (1990) estimated wolverine density to be 10.75/1000 km^2 in continuous and saturated habitat in the south-central Yukon. The estimate using known wolverines (assuming variable habitat quality and not all habitat is saturated) was 5.65/1000 km^2. The total population estimate for about 85% of the territory was a resident population of 2503 wolverine, and a fall population of 4171, including juveniles and transients (Banci 1987). The estimate was based on habitat suitability estimates (area trapped, trapper-years and numbers of wolverines harvested) which were biased. Banci (1987) assumed that "trapper-years" were a standard unit of effort among ecoregions; however, a trapper's effort on small, easily accessible trapping concessions near communities and roads is typically much greater than that on large, remote, fly-in concessions. This is true in terms of numbers of traps set, area covered, and length of trapping sessions. Banci's estimates based on this method are believed to be underestimates for the Yukon. Wolverine density estimates (e.g., Banci 1994) are remarkably consistent across North American ecozones when estimates based on habitat suitability ratings are disregarded. A more realistic wolverine population estimate for the Yukon, based on 100% coverage of the territory and more homogeneous densities in high quality habitat, is 3500 to 4000 residents.

Large scale wolf poisoning through the 1970s had a detrimental impact on wolverines. Poisoning not only removes wolves as a provider of carrion, but the non-target kill of wolverines is significant. Furthermore, wolverines scavenge poisoned wolves, although apparently do not consume stomachs containing poisoned bait (reported in Kelsall 1981). Most of Rausch and Pearson's (1972) 198 Yukon wolverine carcasses were collected from predator control stations. Wolf control using sterilization techniques and community-based trapping programs continues as an ungulate management tool. Aerial wolf control was conducted in two large regions of the Yukon in the 1990s; however, the effect of these programs on wolverines is not known.

The Wildlife Management Advisory Council (North Slope) (1998) reported a harvest of about 10 to 13 wolverines per year by Inuvialuit trappers (from the Northwest Territories) on the Yukon's North Slope (i.e., Arctic ecological area). The population size there is unknown and the only threat is harvest pressure. Wolverines are often observed in association with the Porcupine caribou herd.

Northwest Territories

It has generally been assumed that wolverine densities are variable in the Northwest Territories, being higher in the mountains of the west and in the taiga, and lower in the tundra habitats of the north and east (Figure 3) (Poole, pers. com., 2002). However, large herds of barrenground caribou and associated wolves in the taiga and tundra habitats suggest that wolverines may be more common in those habitats than was once believed (Mulders, pers. com., 2003). The Kitikmeot wolverine carcass study in Nunavut has changed attitudes about wolverine population densities in that region. Wolverines are absent from Banks Island.

Wolverine fur is valued by northerners given its ability to deflect or minimize frost build up. As a result, many wolverine pelts remain in the north and are used domestically for parka trim. The fur trade statistics for the Northwest Territories are based on furs exported to fur auction and not total harvest (Table 1). Based on carcass collection programs in Nunavut Territory (Table 1, discussed in the Nunavut Territory section below), the harvest of many communities may be greatly underestimated. Land claim agreements require harvest studies in three settlement areas in the Northwest Territories, Sahtu, Gwich'in, and Inuvialuit. All hunters and trappers in the communities are interviewed annually regarding their wildlife harvest. Harvests from the Sahtu region were reported to range from 5 to 12 wolverine (1998 to 2001; Bayha, pers. com, 2002) and in the Gwich'in settlement area the harvest ranged from 4 to 14 (Rose 2002). The Inuvialuit harvest ranged between 21 and 62 annually from 1986 to 2000, except in 1997 when the harvest by Inuvik hunters and trappers was estimated to be 62 wolverines, and the total harvest was 124 (0 to 5 in other years) (Fabijan 1991a, 1991b, 1991c, 1995a, 1995b, 1995c,1995d, 1996, 1997, 1998, 2000; Pinard 2001). The Government of the Northwest Territories is considering establishing a territory-wide wolverine carcass collection program to obtain better data on regional harvest levels and patterns, and biological data (Mulders, pers. com., 2003).

Six communities in the Inuvialuit Settlement Region (Aklavik, Holman, Inuvik, Paulatuk, Sachs Harbour and Tuktoyaktuk) have adopted community conservation plans (e.g., Wildlife Management Advisory Council (WMAC-NWT) 2000a and 2000b). Wolverine conservation measures include the identification and protection of important habitats from disruptive land uses, avoidance of den disturbance, and discouraging hunting in summer.

The wolverine populations across the Northwest Territories are believed to be stable, but harvesting pressures and increasing levels of non-renewable resource development may lead to further habitat loss and fragmentation, which may adversely affect wolverine distribution and abundance in the future (Mulders, pers. com., 2003). Studies on the central barrens (Mulders 2000) have shown a healthy wolverine population in that region. There is a pilot project in the barrens using hair-snagging to collect DNA for individual identification and population estimation. GPS collars may also be deployed to assess the effectiveness of the hair sampling grid and to obtain movement data (Mulders, pers. com., 2003).

Studies of genetic variability of Northwest Territories and Nunavut wolverines have shown moderate male-mediated gene-flow among populations, and suggest that all western populations studied were connected (Wilson et al. 2000, Kyle and Strobeck 2001, Chappell 2002, Kyle and Strobeck 2002). Mitochondrial DNA analyses, however, show the genetic independence of populations caused by natal range fidelity exhibited by females (Wilson et al. 2000, Chappell 2002). The implications for wolverine conservation are that individual populations should be conserved and travel and dispersal corridors must be maintained in the matrix between population refugia.

Table 1. Wolverine pelts produced in Canada, 1988/89 to 2000/01.

Season	NL	QC	ON	MB	SK	AB	BC	YT	NT[1]	NU[2]	Canada[3]
1988/89	0	0	10	50	13	36	187	167	100	-	563
1989/90	0	0	9	31	10	40	113	206	93	-	502
1990/91	0	0	5	29	6	34	127	121	92	-	414
1991/92	0	0	7	73	16	30	142	218	201	-	687
1992/93	0	0	4	48	2	44	236	176	93	34 (94)	637
1993/94	0	0	6	76	12	27	97	117	121	29 (82)	512
1994/95	0	0	8	52	11	23	186	145	119	15 (94)	559
1995/96	0	0	18	45	7	9	135	72	59	5 (85)	350
1996/97	0	0	14	46	14	27	230	161	86	26 (132)	604
1997/98	0	0	12	66	10	50	152	118	175	24 (145)	607
1998/99	0	0	4	33	4	40	123	104	62	15 (111)	385
1999/00	0	0	4	18	6	10	160	157	99	12 (108)	466
2000/01	0	0	4	53	23	15	170	188	56	(113)	509
Total	0	0	105	620	134	370	2058	1950	1356	160 (963)	6795

Sources: Statistics Canada, Census of Wildlife Pelt Production, except:
BC – 2000/01 (B.C. Fur Harvest Return System).
ON – 2000/01 (Dawson, pers. com., 2002).
MB – 2000/01 (Berezanski, pers. com., 2002).
SK – 2000/01 (Arsenault, pers. com., 2002).
AB – 2000/01 (Kosinski, pers. com., 2002).
YT – 2000/01 (Slama and Jessup, pers. com., 2002).
NT – 2000/01 (Erasmus, pers. com., 2002).
NU – Carcass collections; Dumond, pers. com. 2003).

Note: Pelt production statistics represent each jurisdiction's best estimate of total harvest based on furs exported to auction or furs sealed. Furs retained for domestic use are not included in the harvests of Northwest Territories and Nunavut although they represent a significant proportion of the total harvest. This is discussed further in the text.

[1]Northwest Territories includes Nunavut to 1991/92.
[2]Data collection began for Nunavut in 1992/93 for political reasons related to an Inuit land claim, in preparation for the establishment of Nunavut as a territory, which occurred on April 1, 1999. Data in parentheses is based on carcass collections.
[3]Not including carcass data for Nunavut.

Nunavut Territory

Wolverine densities are moderate in the west and low on the arctic islands and eastern Nunavut (Figure 3), where numbers are believed to be stable, but sensitive to harvest pressures. As in the Northwest Territories, wolverine fur is prized, and most of the pelts are used domestically for parka trim. The fur trade statistics for Nunavut, too, are based on furs exported to fur auction and not total harvest. Table 1 shows fur trade statistics compared with numbers of carcasses collected in the Kitikmeot wolverine carcass study (Dumond and Krizan, pers. com., 2002), and it serves to illustrate that the fur trade statistics underestimate harvest in Nunavut as in the Northwest Territories. The carcass numbers are believed to represent up to 90% of the total wolverine harvest

(Mulders, pers. com., 2003). Nunavut became a territory on April 1, 1999, but pelt and carcass data are presented for the region from 1992-93.

Wolverines may be especially vulnerable on the arctic tundra, where visibility and snowmobile access are good. Moderate to high harvest may take place near communities and concentrations of caribou, depending on recruitment from neighbouring population refugia. Studies of wolverine metapopulation dynamics and the genetic and morphological variation within and among wolverine populations in Nunavut and other jurisdictions are summarized in the Northwest Territories discussion above.

British Columbia

Wolverine numbers are believed to be stable over much of British Columbia, where they have been estimated at 2089 to 3567 individuals (Lofroth, pers. com., 2003). Densities estimated by Quick (1953) in northeast British Columbia were 4.76/1000 km^2. Wolverines may be declining in the southeast, where habitat and disturbance pressures are greatest; however, no trend data are available (Lofroth, pers. com., 2002). Krebs and Lewis (2000) and Krebs (pers. com., 2003) estimate an average density of 6.16/1000 km^2 in southeastern British Columbia. Forestry, ranching, oil and gas development, human access and human settlement are negatively impacting habitats in British Columbia. Declining caribou herds, linked to logging activities, are a threat to wolverines. A Revelstoke area wolverine sample showed signs of genetic differentiation from the more northern populations (Kyle and Strobeck 2002).

The Vancouver Island population is believed to be very low, and possibly extirpated (Lofroth, pers. com., 2002) as there have been no sightings since 1992 (Appendix 1). There are many threats to wolverines on Vancouver Island including extensive clear-cut forest harvesting, human settlement, and human activity, including several transportation corridors. The Vancouver Island marmot, a potential summer food for denning females, is endangered (COSEWIC 2001).

Alberta

A rabies control program in the 1950s, involving the non-selective poisoning of about 5,500 wolves, is believed to have had a serious impact on wolverines which would have taken decades to recover from (Petersen 1997). Petersen (1997) believed that trapping pressure for wolverines was low, since the low density populations would be difficult to target, even with the incentive of high fur prices. Experience from the southern Yukon, where wolverines are common, suggests that they can be successfully targeted using selective trapping methods. The quota of one wolverine per trapline further limits trapper effort.

The extent of recent habitat loss and changes in ungulate populations is unknown, but land use activities such as agriculture, forestry, and oil and gas development are occurring within the wolverines' present range. Recent opinion surveys of trappers in Alberta indicated a stable population north of 56°N latitude but declining elsewhere in

1987, and a province-wide declining population in 1994 (Petersen 1997). Wolverines are currently most abundant in the western areas. The current range and relative abundance of wolverines in Alberta (Figure 3) were inferred largely from fur harvest data. Poole and Mowat (2001) noted a decrease in the density of harvest locations over time, but low sample sizes hampered this analysis. A decline in wolverine harvests noted since the 1970s was due in part to restrictive quotas which were imposed in the late 1980s (Poole and Mowat 2001). Wolverine harvests were correlated with lynx harvests and lynx pelt price, suggesting the opportunistic harvest of wolverines while trapping lynx. The Alberta Research Council and the Alberta Fish and Wildlife Service are experimenting with the use of hair capture techniques, camera traps and snow tracking as long-term monitoring tools to assess wolverine distribution and abundance trends in boreal and montane Alberta (Mowat 2001, Besko and Wilkinson, pers. com., 2002, Fisher 2003).

Saskatchewan

Wolverine populations are not monitored in Saskatchewan, where they are believed to be rare in the southern boreal forest, but common in the north (total population < 1000) and possibly declining. The major threats are trapping pressure and habitat fragmentation from new roads within their range (Keith, pers. com., 2002). Habitat losses due to forestry and other land uses are also occurring.

Manitoba

Wolverines inhabit the northern part of the province, north of 53° latitude (Berezanski, pers. com., 2002). Highest densities appear to be in the northeast and northwest; however, the northcentral region receives less trapping effort and may represent a population reservoir (Berezanski, pers. com., 2002). The species was historically rare in southern Manitoba, where human developments forced the range limit north. The genetic structure of wolverine populations of Manitoba and northwestern Ontario is similar, but relatively distinct from other populations (Kyle and Strobeck 2002), suggesting that gene flow may be limited between these peripheral populations and other sources. Conservation efforts, including the re-establishment of gene flow between peripheral and core populations, were recommended. Chappell (2002) also found a high level of structuring of mitochondrial DNA among 9 wolverine populations in the Northwest Territories, Nunavut and Manitoba, indicating site fidelity among female wolverine and male-biased gene flow.

The wolverine is apparently not as rare as once thought in Manitoba (van Zyll de Jong 1972, 1975; Holbrow 1976). Van Zyll de Jong's (1972) population estimate of 60 wolverines was based on fur sales records. A population increase likely followed a cessation of indiscriminate wolf poisoning in the mid-1970s, a subsequent increase in the wolf population, and finally, the adoption of a limited harvest season (Johnson 1990). Johnson (1990) estimated the Manitoba wolverine population at 500 to 800, and more recently the population has been estimated at 1200 to 1600 (Berezanski, pers. com., 2002). The population is thought to be stable to increasing at present and there

have been many recent sightings across southern Manitoba. Wolverine populations in the northeast may be benefiting from the increase in the Pen Island caribou herd, which is having the same beneficial effect in Ontario (Dawson 2000). Current threats include logging. Wolverine harvest effort is expected to decline concurrent with a decline in the number of active trappers and a transfer of effort to more lucrative furbearers (Berezanski, pers. com., 2002).

Ontario

Wolverines are found in small numbers in northwestern Ontario following declines since the 1800s (Dauphiné 1989). There is some evidence that numbers increased in the Fort Severn area since the 1970s concurrent with increases in caribou numbers (Dawson 2000). The Pen Islands caribou population may have declined since 1994, and wolverine harvests also declined in the 1990s (Dawson, pers. com., 2002). The small population of wolverines on the coast of James Bay in the Cape Henrietta Maria region may have been extirpated in the 1970s (Dawson 2000). Wolverine range in Ontario is still not clearly defined, but they appear to be recolonizing some areas in northwestern Ontario (Dawson 2000). Kelsall (1981) believed that the wolverines in Ontario were isolated from those in Quebec and Labrador, and there is no recent evidence to the contrary.

Timber harvesting is occurring in the southern portion of wolverine range (Dawson 2000) and is a threat to populations. A zero quota was applied to wolverine prior to the 2001-02 trapping season; however, 3 accidental and nuisance kills occurred (Dawson, pers. com., 2002). Treaties in northern Ontario allow for Aboriginal peoples to harvest in a manner to which they were accustomed to prior to treaty signing (Heydon, pers. com., 2002). This allows them to trap wolverine for their own use. These rights may be infringed upon for the protection of a threatened species; however, the degree to which a right may be infringed upon is evolving and not set in policy at present.

A camera trapping project was initiated in March 2001 in the Red Lake area to refine the southern limit of wolverine distribution. Aerial surveys conducted in February 2003 indicated a relatively continuous distribution in northwestern Ontario, where 103 tracks were intersected on 5700 km of transects (Magoun, pers. com., 2003). The area to the east will be surveyed in 2004. Additional studies include the collection of Aboriginal Traditional Knowledge (Dawson, pers. com., 2002).

Quebec and Labrador

Wolverines have not been confirmed to occur in Quebec since 1978, and the population status at the present time is uncertain (Fortin et al. 2002). There is a consensus among local biologists that the species is either extremely rare or extirpated. The species was never common. Historic wolverine harvest data for Quebec are considered unreliable as there is no proof that any of the pelts attributed to Quebec (or Labrador) came from that region, since fur trading companies operated over a very large area (Obbard et al. 1987). There have been close to 60 unconfirmed sightings

from both jurisdictions since 1935, but these may be immigrants, rather than indicators of a local breeding population. Sightings are believed to be underreported. The last capture was in the Schefferville area in 1978.

Wolverines have not been verified in Labrador since the 1950s (Brazil, pers. com., 2002); however, about 16 sightings have been reported since then. A species at risk stewardship program has been initiated to inform communities about the status of wolverines and other species at risk (McNeill, pers. com., 2002). Aboriginal traditional and local knowledge, including historical and recent observations of wolverine are being collected. The most recent unconfirmed sighting was near Nain in April 2002, when E. Merkuratsuk observed and followed tracks (reported by McNeill, pers. com. 2002).

Population declines of the eastern wolverine are thought to be due to trapping and hunting in the late 19th C., dwindling caribou herds in the early 20th C., human encroachment on habitat, reductions in the numbers of wolves, and the indiscriminate use of poison baits. Hunting and trapping wolverines is now prohibited, and wolves and caribou have recovered substantially. Despite the reversal of these negative ecological factors, there has been no evidence of a coincidental recovery of wolverines. The accidental capture of wolverines in traps set for other species poses some risk to recovery. Logging and hydroelectric reservoirs consume wolverine habitat. The area of suitable habitat remaining has been estimated at 500,000 km^2.

A draft recovery plan (Fortin et al. 2002) has the following 4 main objectives:

1. achieve a population of 100 wolverines (a minimum viable population).
2. maintain this population for 10 years (when natural increases should be realized).
3. prevent wolverine losses attributable to human activities, and
4. ensure that habitats are available in sufficient quantity and quality to attain the population objective

New Brunswick

Evidence of the wolverine's presence in New Brunswick is sketchy, consisting entirely of brief mention in early written works (Sabine, pers. com., 2002). Wolverines have been extirpated from New Brunswick, probably since the early 1800s. There have been no recent sightings, and there are no plans for reintroduction of the species to the province.

National parks

Parks Canada maintains a database on species at risk, including observations and population status assessments (Alvo, pers. com., 2002). Wolverine population assessments are generally not based on field studies per se. There is an ongoing study in Vuntut National Park in the Yukon to obtain information on the status and ecology of mustelids, in particular wolverine (Henry, pers. com., 2002; Henry 2003). The study

uses winter track-transects, carcass collections, Aboriginal traditional knowledge, and local knowledge. There is a continuing wolverine track monitoring program in Kluane National Park and Reserve, Yukon (Henry, pers. com., 2002), and a wolverine track survey was conducted in the Chilkoot Trail National Historic Site, in British Columbia, in 2003 (Slough and Rivard 2003). Poll (reported by Alvo, pers. com., 2002) estimates the combined population of Mount Revelstoke and Glacier National Parks to be 25 wolverines (included in the British Columbia population estimate). Wolverine trapping by Aboriginal peoples is permitted in all national parks in the 3 northern territories, and in the Alberta portion of Wood Buffalo National Park, and Wapusk National Park in Manitoba (where licensed trapping is also permitted). Trapping effort is believed to be minimal, however.

Canadian wolverine population estimate

Western wolverine population estimates (mature individuals) are available only for the Yukon Territory (3500 to 4000), British Columbia (2089 to 3567), and Manitoba (1200 to 1600). The available information suggests that populations in the remaining jurisdictions are approximately as follows: Alberta (1500 to 2000, wolverine range is relatively extensive, with some high density areas), Saskatchewan (1000, likely less than in Manitoba), Ontario (300 or less, based on small range area), Northwest Territories (3500 to 4000, similar to Yukon range area and relative abundance), and Nunavut (2000 to 2500). The total western Canadian wolverine population is therefore estimated at 15,089 to 18,967. Assuming that current harvests are sustainable, then the fall (pre-trapping) population estimate, including juveniles is 2.5% (Golden, pers. com. 2002) to 6% (J. Krebs, pers. com., 2002) or 8% (Gardner et al. 1993) higher than the harvested population; as high as 20,484 wolverines. Considering that average annual harvests of wolverines have exceeded 500 animals, or 2.5% of this population estimate, over the past 13 seasons (Table 1), it appears that the harvest of wolverines is currently sustainable. It is also likely that some jurisdictional wolverine population estimates are low.

The eastern wolverine population in Quebec and Labrador, based on the opinions of eastern jurisdictional biologists, is extremely low and close to extirpation. Recent unconfirmed sightings are still being investigated (Brazil, pers. com., 2003).

Alaska

Wolverine densities in south-central Alaska have been estimated at 4.78/1000 km^2 (Whitman and Ballard 1983), 4.69/1000 km^2 (Becker and Gardner 1992), and 5.2/1000 km^2 (Becker 1991) which are similar to an earlier estimate of 4/1000 km^2 by Quick (1953). Densities on the north slope of Alaska have been estimated at 7.2 to 20.8 wolverines per 1000 km^2 (Magoun 1985, based on home range size). An ongoing study in northwestern Alaska should provide further information on wolverine demographics (Shults, pers. com., 2002). A harvest assessment program indicates that wolverines are abundant and able to withstand a moderate to high harvest near villages, exploiting recruitment and immigration from refugia. There is no wolverine population estimate for Alaska (Golden, pers. com., 2003).

Coterminous United States

The total number of wolverines inhabiting the lower 48 states may be less than 750 (Predator Conservation Alliance 2001). Tenuous populations currently inhabit montane regions in Washington, Oregon (est. of 100 in the Cascade Mountains), California (unknown population), Idaho (est. of 300), western Montana (est. of 300), Wyoming (est. of 50) and Colorado (Banci 1994, estimates from Predator Conservation Alliance 2001). Remnant populations also exist in the southern Rockies (Colorado; Kahn and Byrne 1998) and, possibly, Michigan and Maine.

Estimates of wolverine density in Montana ranged from 15.38/1000 km^2 in high quality habitats in northwest Montana (Hornocker and Hash 1981) to as low as 5 to 6.67/1000 km^2 in fringe habitats (Hash 1987). Copeland (1996) estimated a density of 4.0-5.1/1000 km^2 in Idaho. Without specific studies, estimates of population sizes and trends across most of the wolverine's range in Washington, Oregon, California, Idaho, Montana, Wyoming and Colorado are difficult to assess, and rely largely on accidental captures and reported sightings. A wolverine conservation strategy is being developed by members of the Western Forest Carnivore Committee, starting with historical record evaluation (Quade, pers. com., 2002). Plans to reintroduce wolverines to Colorado are on hold (Wait, pers. com., 2002). Edelmann and Copeland (1999) recommend maintaining and enhancing movement corridors between mountainous habitats in Idaho and Oregon to ensure the colonization of all habitats and regional population persistence.

LIMITING FACTORS AND THREATS

Biological factors

Biological factors that limit wolverine populations include the species' low intrinsic rate of increase and low natural densities which limit population growth rates and the ability to recolonize vacant habitats. Maternal den site availability may also limit successful reproduction. Repopulation may take several decades but is possible where factors favour wolverine survival (Johnson 1990, Vangen et al. 2001). Wolverine population recovery in Manitoba was thought to be due to the cessation of wolf poisoning, which also killed wolverines, the increase in the wolf population following the cessation of poisoning, and a trapping season closing date which offered some protection to females with kits. Habitat factors including an adequate ungulate prey base were also necessary. Recent harvest increases in northeastern Manitoba and northwestern Ontario are attributed to a wolverine population response to increased caribou numbers (Dawson 2000, Berezanski, pers. com., 2002).

Harvest and predator control

Wolverine trapping and hunting continue to be a threat in western jurisdictions; however, harvest management, including trapping closures, limited seasons, quotas,

limited entry, and registered trapping concessions (Slough et al. 1987), and a reduced interest in trapping, have reduced these threats. High pelt prices and a lucrative market to supply zoos and game farms with live wolverines contributed to trapper effort and the overall wolverine harvest in the Yukon. There may be a certain level of financial return per unit effort below which wolverines are not targeted by trappers, as in areas where they are not common (Figure 3). There has been no legal harvest of wolverines in Labrador since 1950, in Quebec since 1981 (except in the James Bay and Northern Quebec Agreement territories) (Fortin et al. 2002) and in Ontario since 2001 (Dawson, pers. com., 2002).

There are winter trapping seasons for wolverines in the four western provinces and 3 territories. These seasons generally begin in November and terminate in January or February, extending to March or April in the territories. Wolverine harvest is prohibited in southern regions of the western provinces where the species is rare or does not occur. There are also fall (August to October) and/or winter hunting seasons in British Columbia and the territories. Bag limits for hunters are generally 1 wolverine, but may be more for residents of the Northwest Territories and Nunavut. There are no quotas for trappers except in Alberta, where the limit is one wolverine.

There is mandatory reporting of wolverines harvested in the Yukon, British Columbia, Alberta and Saskatchewan, either through pelt sealing or provincial fur royalties. Manitoba rescinded pelt sealing in 2001, although all pelts sold or exported must be reported. Wolverine furs exported from the Northwest Territories and Nunavut require permits, however, since a high proportion of wolverines are not exported to fur auctions (Table 1; Nunavut), the harvest has not been accurately documented. Carcass collection programs and harvest studies are being used to monitor harvest in those jurisdictions.

Gardner et al. (1993) estimated that the wolverine population in southcentral Alaska could sustain an annual harvest of 7-8% of the fall population. In a nearby study area the finite rate of population increase (λ) was 1.19, following an annual harvest rate of about 9% (Golden 2001). Golden noted that the annual harvest rate of 9% did not affect wolverine density. There was likely an immigration component from adjacent refugia, but this was not measured. The population was considered healthy and stable, with annual harvests in some areas being low to moderate with respect to annual sustainable yields. Golden (pers. com., 2002), recalculated his statistics using lower birth rates (mean of 0.375 females per adult female per year (F)) giving a λ of 0.86 and an estimated annual sustainable yield of 0.8% of the population. This estimate was based on the relatively small number of litter observations of Magoun (1985) and Copeland (1996). Using larger sample sizes of Pulliainen (1968) Golden arrived at a λ of 0.94 and an estimated annual sustainable yield of 2.5%. This may be more realistic, but it indicates that some local overharvest and exploitation of population refugia may be occurring. In a summary of mortality rates of radio-collared wolverines from 12 studies, J. Krebs (pers. com., 2002) estimated λ at 0.88 in trapped populations and 1.06 in untrapped populations. Again, immigration from untrapped areas is required to sustain wolverines in trapped areas.

Wolf poisoning was curtailed in most of western Canada in the 1970s. Local illegal wolf poisoning was documented in the Yukon in the 1990s and continues in Alberta under special permit. The elimination of poisoning favours wolverine population recovery.

Developments in arctic tundra frequently attract wolverines which may be killed as nuisance animals (Dumond, pers. com., 2002).

Habitat threats

Habitat loss, habitat alienation and habitat fragmentation continue to threaten wolverine populations. Losses result from conversion of natural habitats for human land uses including urban and suburban developments, agriculture, forest plantations, and hydroelectric reservoirs. Clearcut logging does not result in permanent or even necessarily negative changes to habitats. Logging which mimics natural processes, such as fire, windthrow and insect outbreaks, and creates a landscape matrix of uneven aged forest stands, may actually diversify the prey base and maintain or improve wolverine habitat.

Habitat alienation may result from human activities, such as backcountry recreation, which impact wolverine behaviour patterns such as denning, travel and foraging.

Habitats are fragmented by major transportation arteries which impede wolverine movements and ultimately, gene flow and population stability.

Indirect effects on the prey base will also impact wolverine populations. Such effects include overhunting of ungulates, and ungulate population declines due to fragmentation of their habitats. Of particular concern are the declining mountain caribou populations of Alberta and British Columbia. The decline of these populations is linked to forestry practices and human disturbance.

The existence of parks which may act as refugia from trapping and resource developments are not the insurance to continued existence as described by both Kelsall (1981) and Dauphiné (1989). Parks in developed regions run the risk of holding isolated populations. Such fragmentation can lead to destabilization of populations and local extirpations. Wolverine populations within the parks are not buffered from trapping activities around their peripheries. Wolverines that reside partly in refugia are susceptible to harvest mortality. Treaty/Aboriginal and licensed wolverine trapping is permitted in many national parks and some provincial parks in British Columbia and Manitoba. Another problem with the quality of our current parks system to act as wolverine population refugia lies with the allowance of activities within parks including traversing roads (such as the Trans-Canada Highway), access roads, and activities such as snowmobiling and skiing. Major roads may act as barriers to movements (Austin 1998) and recreational activities during the late winter denning period may result in disturbance to females and their litters leading to relocation or abandonment (Magoun and Copeland 1998, Heinemeyer et al. 2001).

Hash (1987) concluded that "The future of the wolverine appears bright. The species has survived the pioneer periods of unregulated trapping, hunting, and predator control, accelerated and irresponsible natural resource development, and widespread habitat degradation". He praised the national parks systems, and our greater environmental awareness and responsibility towards endangered species. This is an optimistic scenario which will require vigilance.

SPECIAL SIGNIFICANCE OF THE SPECIES

Wolverines are perhaps the most sensitive indicators of ecological integrity (Gunn, pers. com., 2002), due to biological characteristics and their dependence on large, connected and intact ecosystems. This is similar to the role typically assigned to the grizzly bear and other large carnivores. Wolverines are vulnerable on many fronts, including habitat fragmentation, overharvest, disturbance and the decline of ungulates.

Wolverines are viewed as one of several species of carnivores that should be used in multi-species conservation planning in the Rocky Mountain region (Carroll et al. 2001). Combinations of focal species are more effective umbrellas that any one species alone.

Wolverines evoke many different emotions from those who interact with them. Aboriginal peoples believe that wolverines have great powers to be either spiritual guides or relentless enemies (Moore and Wheelock 1990). This stems from their belief that long ago animals talked and lived like humans. Wolverines may destroy traps, fur and belongings, yet paradoxically they also have great powers of healing and transformation.

Wolverines are still a much sought after and economically valuable furbearer, and are trapped or hunted over much of their remaining range. The fur is frequently used for trim fur due to its durability and "frost free" characteristics. Wolverines have been given derogatory names such as "devil bear", because of their propensity to rob food caches and cabins and then spoil the remains with its foul scent. They frequently rob traps of their catch, and trap-wise wolverines can be difficult to catch. Most trappers exhibit a great deal of respect for the animal. They are rarely seen, especially in forested areas. Attributes such as ferocity and cunningness have led to a mythology and folklore (Holbrow 1976).

Wolverines rarely prey on domestic animals in North America and so are not direct targets of predator control. Wolverines are a livestock predator in Scandinavia, where they prey on reindeer and domestic sheep (*Ovis aries*) (Landa et al. 1997).

EXISTING PROTECTION OR OTHER STATUS

In Canada, wolverines are harvested in all western jurisdictions. There is no non-Aboriginal harvest in Quebec, Labrador or Ontario (since 2001/02; Dawson, pers. com., 2002). The wolverine is listed as endangered in Newfoundland-Labrador, where it is

protected under the province's endangered species act. In the United States, wolverine harvest is permitted only in Alaska and Montana.

Harvests are managed using variation in season length (including closed seasons), quotas, the use of registered trapping concessions (a form of limited entry), and trapline management by the trapper (Slough et al. 1987). Harvests are monitored through mandatory pelt sealing, year-end harvest reporting, or by monitoring fur exports. Local use of wolverine pelts is common in northern areas (especially the Northwest Territories and Nunavut), where pelt production data (Table 1) underestimate the actual harvest. Community or land claim area-based harvest studies and carcass collection programs have greatly improved wolverine harvest reporting since the 1990s.

Registered trapping concessions are effective in limiting the number of trappers who harvest from any given area, and also provide an incentive for long-term trapline management by the trapper (i.e., overharvest is discouraged). A weaker trapping system is employed in group trapping areas, where members of some northern Aboriginal communities in the Yukon Territory, Northwest Territories and Nunavut have unlimited rights to hunt and trap within large traditional territories near their communities. There is less incentive to manage these areas, as individual trappers have little control over the total harvest.

Wolverines are not listed by the Convention on International Trade in Endangered Species; therefore international trade in wolverines is not monitored or restricted.

The provincial / territorial status rankings for wolverines are given in Table 2. Most rankings are similar to the COSEWIC (COSEWIC 2002) rankings for the eastern and western populations (endangered and special concern, respectively).

Internationally, wolverines are listed as endangered in Norway, Sweden and Finland. Wolverines are ranked vulnerable worldwide (IUCN status – vulnerable, VU – A2c; Hilton-Taylor 2000), facing a high risk of extinction in the wild in the medium-term future due to population declines.

The U.S. Forest Service designated the wolverine a sensitive species in 1993, granting it special consideration during management planning efforts. A petition was filed with the U.S. Fish and Wildlife Service to list the wolverine as a threatened or endangered species, but was subsequently denied in 1995. Another such petition was filed in 2000 (Biodiversity Legal Foundation 2000), citing low numbers and fragmented populations as reasons. State listings for wolverines are threatened (Oregon and California) endangered (Colorado) protected wildlife (Washington), species of special concern (Idaho and Wyoming). There are no state listings for Alaska and Montana where the species is trapped. The trapping season for wolverines was closed in Idaho in 1965, and in 1975, a bag limit of one per trapper was implemented in Montana, where there is an annual harvest of approximately 12 individuals.

Table 2. Status of wolverine in Canada.

	Status				
Jurisdiction	**Provincial**	**Sub-national**	**Comment**	**Global**	**COSEWIC**
NL	Endangered	S1	Critically imperilled		**E (1989)**
QC	Not ranked	S1	Critically imperilled	G4	**E (1989)**
ON	Threatened	S2	Imperilled	G4	**SC (1989)**
MB		S3S4	Vulnerable/apparently secure	G4; G4T4, luscus ssp.	**SC (1989)**
SK	Sensitive	S3S4	Data deficient	G4	**SC (1989)**
AB	Blue		May be at risk; data deficient status has been recommended		**SC (1989)**
BC, ***luscus* ssp.**	Blue	S3	Vulnerable	G4T4	**SC (1989)**
BC, ***vancouverensis* ssp.**	Red	S1	Critically imperilled	G4T1Q	**Not addressed**
YT	Yellow	S3	Vulnerable		**SC (1989)**
NT	Secure				**SC (1989)**
NU	Sensitive				**SC (1989)**

Sources:
NL (Bredin, pers. com., 2002).
QC (Québec Société de la Faune et des Parcs, Espèces Fauniques Menacées ou vulnérables au Québec, web site: http://www.fapaq.gouv.qc.ca/fr/etu_rec/esp_mena_vuln/esp/carcajou.htm [accessed May 2003].
ON (Threatened status recommended by Dawson 2000) (Ontario Natural Heritage Information Centre, web site: http://www.mnr.gov.on.ca/MNR/nhic/species/listout.cfm?el=am [accessed May 2003].
MB (Berezanski, pers. com., 2002; Manitoba CDC, web site: http://web2.gov.mb.ca/conservation/cdc/species/species.php?search_type=animal&search_text=wolverine&action=Submit&action=Submit [accessed May 2003].
SK (Saskatchewan CDC, Keith, pers. com., 2002).
AB (Petersen 1997, Alberta Sustainable Resource Development 2000, Kosinski, pers. com., 2002).
BC (Cannings et al. 1999).
YT (Yukon Department of Renewable Resources 2000).
NT (Northwest Territories Resources, Wildlife and Economic Development 2000).
NU (Krizan, pers. com., 2002).
COSEWIC (COSEWIC 2002).

SUMMARY OF STATUS REPORT

Wolverine range has been reduced over much of southern and eastern Canada since the mid-19th century. Although the exact range limits of viable wolverine populations pre-European settlement are unknown, the wolverine range has receded north in the Prairie Provinces and Ontario, is extirpated from New Brunswick, and may possibly be extirpated from Quebec and Labrador.

The western population is relatively healthy but is not a source for the natural repopulation of the eastern wolverine in Quebec and Labrador. Harvest restrictions and naturally increasing caribou herds were not sufficient to prevent the extirpation of the eastern population. There is a draft recovery plan in place for wolverines in Quebec and Labrador.

There is evidence of restricted gene flow to at least two areas within the range of the western population: the Revelstoke population of British Columbia, and the sub-populations of northwestern Ontario and Manitoba (Kyle and Strobeck 2002). The Southern Mountain sub-population of British Columbia and Alberta is more vulnerable to land use practices which may fragment and destabilize the population in the future. The status of other isolated populations, namely those of the Pacific islands (Vancouver and Pitt), and the arctic islands, is unknown. The Vancouver Island wolverine population may be extirpated.

Biological factors that contribute to the wolverine's vulnerability to population decline and ability to recolonize include large spatial requirements, low densities, low reproductive rates, and poor juvenile survival. Despite these factors, given time, wolverines are able to rebuild their populations and reclaim former ranges. Threats to the populations have included habitat losses, trapping and hunting, poisoning (during wolf control programs), and disruptions to important ecosystem components such as ungulates (as a primary winter food source) and wolves (a carrion provider). The disturbance of denning females is a growing problem in the mountains of western Canada, where winter recreational use is growing rapidly. Parks and protected areas are susceptible to recreational impacts, transportation corridor impacts and, in some cases, trapping.

Habitat losses are not as significant today as they were during earlier periods of human settlement. More important effects on habitats are fragmentation and indirect effects on the prey base, most notably mountain caribou populations in western Canada.

The reversal of several factors which have reduced either the range of wolverines or their populations in local areas has resulted in apparent (based on harvests and sightings) population and range recoveries. Government subsidized poisoning of wolves in most of western Canada has been terminated. Several large caribou herds in Manitoba, Ontario, Quebec and Labrador have increased naturally. Trapping is now only permitted in the 4 western provinces and the 3 territories. Wolverine harvest management systems used by both governments and trappers are improving. Local wolverine population recoveries have been noted in northwestern Ontario and northern Manitoba. Populations in the 3 northern territories and northern British Columbia are healthy and stable, although local concerns exist. Possible declines have been noted in Alberta. The western wolverine population remains vulnerable on several fronts.

Some local and traditional knowledge was used in this report (such as trapper and harvest surveys, and observations of wolverine in Quebec and Labrador); however, other relevant Aboriginal traditional knowledge (ATK) is not well documented or available for use. A pilot project on wolverine ATK in northern Canadian communities is being conducted to investigate how ATK can be documented, described and utilized in the species assessment process (Cardinal, pers. com., 2003). The project will not gather all ATK, but will use information from the 3 territories and existing studies in Labrador.

TECHNICAL SUMMARY

Gulo gulo
Wolverine Carcajou
Western Population
Yukon Territory, Northwest Territories, Nunavut Territory, British Columbia, Alberta, Saskatchewan, Manitoba, and Ontario.

Extent and Area information	
• *extent of occurrence (EO)(km²)*	*6.1 million km²*
• *specify trend (decline, stable, increasing, unknown)*	Stable overall, locally decreasing
• *are there extreme fluctuations in EO (> 1 order of magnitude)?*	No
• *area of occupancy (AO) (km²)*	*Estimated at 5.5 million km²*
• *specify trend (decline, stable, increasing, unknown)*	Stable
• *are there extreme fluctuations in AO (> 1 order magnitude)?*	No
• *number of extant locations*	1
• *specify trend in # locations (decline, stable, increasing, unknown)*	Stable
• *are there extreme fluctuations in # locations (>1 order of magnitude)?*	No
• *habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat*	Stable in area, locally declining quality
Population information	
• *generation time (average age of parents in the population) (indicate years, months, days, etc.)*	4 years
• *number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)*	15,000 to 19,000
• *total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals*	Stable
• *if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)*	
• *are there extreme fluctuations in number of mature individuals (> 1 order of magnitude)?*	No
• *is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., ≤ 1 successful migrant / year)?*	No
• *list each population and the number of mature individuals in each*	
• *specify trend in number of populations (decline, stable, increasing, unknown*	
• *are there extreme fluctuations in number of populations (>1 order of magnitude)?*	
Threats (actual or imminent threats to populations or habitats)	
- harvest	
- Declining caribou and other ungulate populations (causes: overhunting, habitat losses listed below)	
- habitat losses due to forestry, agriculture, urbanization, oil and gas development, hydroelectric reservoirs	
- habitat fragmentation due to linear developments	
- disturbance caused by recreational activities such as snowmobiling and skiing	
Rescue Effect (immigration from an outside source)	High
• *does species exist elsewhere (in Canada or outside)?*	Yes; United States (Alaska and coterminous states), Eurasia
• *status of the outside population(s)?*	Special concern, threatened, endangered
• *is immigration known or possible?*	Yes
• *would immigrants be adapted to survive here?*	Yes
• *is there sufficient habitat for immigrants here?*	Yes
Quantitative Analysis	n/a

TECHNICAL SUMMARY

Gulo gulo
Wolverine — Carcajou
Eastern Population
Quebec and Labrador

Extent and Area information	
• *extent of occurrence (EO)(km²)*	*Unknown, Formerly 1.2 million km²*
• *specify trend (decline, stable, increasing, unknown)*	Decline
• *are there extreme fluctuations in EO (> 1 order of magnitude)?*	No
• *area of occupancy (AO) (km²)*	*Unknown; formerly 500,000 km²*
• *specify trend (decline, stable, increasing, unknown)*	Decline
• *are there extreme fluctuations in AO (> 1 order magnitude)?*	No
• *number of extant locations*	possibly 1
• *specify trend in # locations (decline, stable, increasing, unknown)*	Unknown
• *are there extreme fluctuations in # locations (>1 order of magnitude)?*	No
• *habitat trend: specify declining, stable, increasing or unknown trend in area, extent or quality of habitat*	Declining
Population information	
• *generation time (average age of parents in the population) (indicate years, months, days, etc.)*	4 years
• *number of mature individuals (capable of reproduction) in the Canadian population (or, specify a range of plausible values)*	very few, possible none
• *total population trend: specify declining, stable, increasing or unknown trend in number of mature individuals*	Declining
• *if decline, % decline over the last/next 10 years or 3 generations, whichever is greater (or specify if for shorter time period)*	Unknown
• *are there extreme fluctuations in number of mature individuals (> 1 order of magnitude)?*	Unknown
• *is the total population severely fragmented (most individuals found within small and relatively isolated (geographically or otherwise) populations between which there is little exchange, i.e., ≤ 1 successful migrant / year)?*	Unknown
• *list each population and the number of mature individuals in each*	Unknown
• *specify trend in number of populations (decline, stable, increasing, unknown)*	Unknown
• *are there extreme fluctuations in number of populations (>1 order of magnitude)?*	No
Threats (actual or imminent threats to populations or habitats)	
- forestry, hydroelectric developments	
- unstable or declining caribou populations	
Rescue Effect (immigration from an outside source)	Low
• *does species exist elsewhere (in Canada or outside)?*	Yes; Western Canada, United States, Eurasia
• *status of the outside population(s)?*	Special concern, threatened, endangered
• *is immigration known or possible?*	Yes
• *would immigrants be adapted to survive here?*	Yes
• *is there sufficient habitat for immigrants here?*	Yes
Quantitative Analysis	n/a

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BIOGRAPHICAL SUMMARY OF CONTRACTOR

Brian Slough obtained an M.Sc. from Simon Fraser University. His thesis on land capability classification for beaver, *Castor canadensis*, led him to a 15-year career as furbearer management biologist with the Yukon Fish and Wildlife Branch. The wolverine is an important furbearer for Yukon trappers, and as such, considerable effort was spent monitoring and studying wolverines.

Wolverine harvests by trappers and hunters were carefully monitored with a state-of-the-art fur harvest monitoring system. Wolverine populations were monitored using winter track-count and trapper questionnaire indices. The Yukon Trapper Questionnaire is a vehicle for obtaining local knowledge from Aboriginal and non-Aboriginal trappers on furbearer population levels and trends. Mr. Slough initiated, facilitated and assisted with a major wolverine field study in the Yukon, the first in Canada.

The information collected on wolverines was applied to a wolverine status report, wolverine management guidelines, land use guidelines for wolverines and wolverine trapline management recommendations, which are in a brochure and are presented annually at Yukon trapper education workshops.

He has published work on furbearer species including beaver, arctic fox, *Alopex lagopus,* American marten, *Martes americana*, and Canada lynx, *Lynx canadensis*, and has also written about trapline management and furbearer management in northern and western Canada. Since leaving the Yukon government in 1996, Mr. Slough has conducted environmental assessments, protected areas research, and field studies on wolverines, rodents, shrews, bats and amphibians.

AUTHORITIES CONSULTED

Alvo, R. May 2002. Conservation Biologist/National Database Manager, Species at Risk, Ecological Integrity Branch, Parks Canada, Room 375, 4th Floor, 25, rue Eddy, Hull, QC K1A 0M5.

Arsenault, A. May 2002. Wildlife Population Biologist, Saskatchewan Environment, Fish and Wildlife Branch, 112 Research Drive, Saskatoon, SK S7K 2H6.

Bayha, J. December 2002. Harvest Study Coordinator, Sahtu Renewable Resources Board, P.O. Box 134, Tulita, Northwest Territories X0E 0K0.

Berezanski, D. May 2002. Furbearer Management Unit, Wildlife & Ecosystem Protection Branch, Manitoba Conservation, Box 24, 200 Saulteaux Cres. Winnipeg, MB R3J 3W3.

Besko, M. June 2002. Regional Endangered Species Specialist, Northeast Boreal Region, Alberta Sustainable Resource Development, Fish and Wildlife Service, #111, 4999-98 Ave., Edmonton, Alberta T6B 2X3.

Brazil, J. May 2002 and May 2003. Endangered Species and Biodiversity Section, Inland Fish and Wildlife Division, Department of Tourism, Culture and Recreation, Box 2007, Corner Brook, Newfoundland A2H 7S1.

Bredin, K. May 2002. Zoologist, Atlantic Conservation Data Centre, Mount Allison University, P.O. Box 6416, Sackville, NB E4L 1G6.

Cardinal, N. May 2003. School for Resource and Environmental Studies, Dalhousie University, 1322 Robie Street, Halifax, NS B3H 3J5.

Carrière, S. April 2002. Ecosystem Management Biologist, Wildlife & Fisheries Division, Department of Resources, Wildlife & Economic Development, Government of the Northwest Territories, 600, 5102-50th Avenue, Yellowknife, NT X1A 3S8.

Dawson, N. May 2002. Wildlife Assessment Program Leader, Northwest Region, Ontario Ministry of Natural Resources, Thunder Bay, Ontario.
Donovan, M. May 2002. Biological Information Coordinator, BC Conservation Data Centre, Ministry of Sustainable Resource Development, Victoria BC.
Dumond, M. April 2002 and January 2003. Wildlife Biologist (Carnivores), Department of Sustainable Development, Government of the Nunavut Territory, Kitikmeot Region, NU.
Erasmus, G. May 2002. Resource Development Officer, Resources, Wildlife & Economic Development, Government of the Northwest Territories.
Fortin, C. April 2002. Coordonateur animaux à fourrure, Société de la faune et des parcs du Québec, 675, boul. René-Lévesque E. 11e étage, bte 92, Québec, QC G1R 5V7.
Galipeau, J. April 2002. Wildlife Management Assistant, Nunavut Wildlife Management Board, Box 1379, Iqaluit, NU X0A 0H0.
Geogeon, N. May 2002. Secretary Treasurer, Hunting, Fishing and Trapping Coordinating Committee, 383, St. Jacques Street, Suite C220, Mezzanine Level, Montreal, Québec H2Y 1N9.
Golden, H. September 2002 and May 2003. Furbearer Biologist, Southcentral Region, Alaska Department of Fish and Game, Division of Wildlife Conservation, 333 Raspberry Road, Anchorage, AK 99518-1599, U.S.A.
Gunn, A. June 2002. Wildlife and Fisheries Division, Northwest Territories Department of Resources, Wildlife and Economic Development, Government of the Northwest Territories, Yellowknife, NT
Hayes, R.D. May 2002. Consulting biologist, Haines Junction, YT.
Henry, D. May 2002. Conservation Ecologist, Yukon Field Unit, Parks Canada, P.O. Box 5495, Haines Junction, YT Y0A 1L0.
Heydon, C. September 2002. Fur Program Biologist, Fish and Wildlife Branch, Ontario Ministry of Natural Resources, 300 Water St., P.O. Box 7000, Peterborough, ON K9J 8M5.
Jessup, H. June 2002 and January 2003. Wildlife Harvest Manager, Fish and Wildlife Branch, Department of Environment, Government of the Yukon Territory, P.O. Box 2703, Whitehorse, YT Y1A 2C6.
Jung, T. June 2002. Senior Biologist, Fish and Wildlife Branch, Department of Environment, Government of the Yukon Territory, P.O. Box 2703, Whitehorse, YT Y1A 2C6.
Keith, J. April 2002. Fish and Wildlife Branch, Department of Environment & Resource Management, 3211 Albert Street, Regina, SK S4S 5W6.
Kosinski, T. May 2002. Species at Risk Biologist, Fisheries and Wildlife Management, Fish and Wildlife Division, Sustainable Resource Development, 7th floor O.S. Longman Building, 6909-116 Street Edmonton AB T6H 4P2.
Krebs, J. April 2002. Columbia Basin Fish & Wildlife Compensation Program Senior Wildlife Biologist, B.C. Hydro, 103-333 Victoria Street, Nelson, BC V1L 4K3.
Krizan, J. May 2002. Wildlife Biologist (Carnivores), Department of Sustainable Development, Government of the Nunavut Territory, Box 1000, Stn 1170, Iqualuit, NU X0A 0H0.

Kyle, C. April 2002. Ontario Ministry of Natural Resources.
Lofroth, E. April 2002. Ecosystem Specialist, Biodiversity Branch, Ministry of Water, Land and Air Protection, P.O. Box 9338, Stn Prov Govt, Victoria, BC V8W 9M4.
Magoun, A. Director, The Wolverine Foundation, 3680 Non Road, Fairbanks, AK 99709.
McNeill, A. May 2002. Wildlife Stewardship Facilitator, Labrador Inuit Association, P.O. Box 909, Station "B", Happy Valley, LB A0P 1E0.
Mulder, R. April 2002. GIS Technician, Canadian Parks and Wilderness Society, Yukon Chapter, P.O. Box 31095, Whitehorse, YT Y1A 5P7.
Mulders, R. May 2003. Carnivore/Fur Biologist, Wildlife and Fisheries Division, Resources, Wildlife and Economic Development, Government of the Northwest Territories, 600, 5102-50th Avenue, Yellowknife, NT X1A 3S9.
Poole, K. June 2002. Wildlife Research Biologist, Aurora Wildlife Research, 2305 Annable Road, Nelson, B.C. V1L 6K4.
Popko, R. November 2002. Wildlife Technician, Resources, Wildlife and Economic Development, Government of the Northwest Territories, Norman Well, NT.
Quade, C. May 2002. 3322 S. Williamsburg Way, Boise, ID, U.S.A.
Rothfels, M. April 2002. RENEW Secretariat, c/o Canadian Wildlife Service, Environment Canada, Hull, QC K1A 0H3.
Sabine, D. April 2002. Biologist, Species at Risk Program, Fish & Wildlife Branch, Department of Natural Resources & Energy, P.O. Box 6000, Fredericton, NB E3B 5H1.
Shults, B. May 2002. U.S. National Parks Service, Northwest Alaska Areas, P.O. Box 1029, Kotzebue, AK 99503, U.S.A.
Slama, H. June 2002. Furbearer Technician, Fish and Wildlife Branch, Department of Environment, Government of the Yukon Territory, P.O. Box 2703, Whitehorse, YT Y1A 2C6.
Thiesenhausen, K. April 2002. Resource Person, Wildlife Management Advisory Council (NWT), Box 2120, Inuvik, NT X0E 0T0.
Wait, S. April 2002. Wildlife Biologist, Colorado Division of Wildlife, Department of Natural Resources, Durango, Colorado.
Wilkinson, L. May 2002. Regional Endangered Species Specialist, Alberta Fish and Wildlife Service, Courier Box 27 Prov. Bldg., #203, 111-54 Street, Edson, AB T7E 1T2.
Woodley, S. October 2002. Chief Scientist, Parks Canada.